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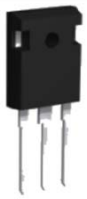
# RGT40TS65D

**650V 20A Field Stop Trench IGBT** Datasheet

| | |
|---|---|
| $V_{CES}$ | 650V |
| $I_{C(100°C)}$ | 20A |
| $V_{CE(sat)}$ (Typ.) | 1.65V |
| $P_D$ | 144W |

## ●Outline

TO-247N



(1)(2)(3)

## ●Features

1) Low Collector - Emitter Saturation Voltage

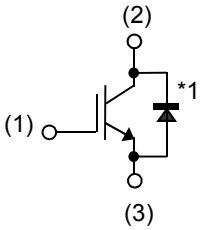
2) Low Switching Loss

3) Short Circuit Withstand Time 5μs

4) Built in Very Fast & Soft Recovery FRD
(RFN - Series)

5) Pb - free Lead Plating ; RoHS Compliant

## ●Inner Circuit




(1) Gate
(2) Collector
(3) Emitter

*1 Built in FRD

## ●Applications

General Inverter

UPS

Power Conditioner

Welder

## ●Packaging Specifications

| | | |
|---|---|---|
| Type | Packaging | Tube |
| | Reel Size (mm) | - |
| | Tape Width (mm) | - |
| | Basic Ordering Unit (pcs) | 450 |
| | Packing code | C11 |
| | Marking | RGT40TS65D |

## ●Absolute Maximum Ratings (at $T_C$ = 25°C unless otherwise specified)

| Parameter | | Symbol | Value | Unit |
|---|---|---|---|---|
| Collector - Emitter Voltage | | $V_{CES}$ | 650 | V |
| Gate - Emitter Voltage | | $V_{GES}$ | ±30 | V |
| Collector Current | $T_C$ = 25°C | $I_C$ | 40 | A |
| | $T_C$ = 100°C | $I_C$ | 20 | A |
| Pulsed Collector Current | | $I_{CP}$ *1 | 60 | A |
| Diode Forward Current | $T_C$ = 25°C | $I_F$ | 35 | A |
| | $T_C$ = 100°C | $I_F$ | 20 | A |
| Diode Pulsed Forward Current | | $I_{FP}$ *1 | 60 | A |
| Power Dissipation | $T_C$ = 25°C | $P_D$ | 144 | W |
| | $T_C$ = 100°C | $P_D$ | 72 | W |
| Operating Junction Temperature | | $T_j$ | −40 to +175 | °C |
| Storage Temperature | | $T_{stg}$ | −55 to +175 | °C |

*1 Pulse width limited by $T_{jmax.}$

## ●Thermal Resistance

| Parameter | Symbol | Values | | | Unit |
|---|---|---|---|---|---|
| | | Min. | Typ. | Max. | |
| Thermal Resistance IGBT Junction - Case | $R_{\theta(j-c)}$ | - | - | 1.04 | °C/W |
| Thermal Resistance Diode Junction - Case | $R_{\theta(j-c)}$ | - | - | 2.28 | °C/W |

## ●IGBT Electrical Characteristics (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Collector - Emitter Breakdown Voltage | $BV_{CES}$ | $I_C$ = 10μA, $V_{GE}$ = 0V | 650 | - | - | V |
| Collector Cut - off Current | $I_{CES}$ | $V_{CE}$ = 650V, $V_{GE}$ = 0V | - | - | 10 | μA |
| Gate - Emitter Leakage Current | $I_{GES}$ | $V_{GE}$ = ±30V, $V_{CE}$ = 0V | - | - | ±200 | nA |
| Gate - Emitter Threshold Voltage | $V_{GE(th)}$ | $V_{CE}$ = 5V, $I_C$ = 13.3mA | 5.0 | 6.0 | 7.0 | V |
| Collector - Emitter Saturation Voltage | $V_{CE(sat)}$ | $I_C$ = 20A, $V_{GE}$ = 15V | | | | V |
| | | $T_j$ = 25°C | - | 1.65 | 2.1 | |
| | | $T_j$ = 175°C | - | 2.15 | - | |

●**IGBT Electrical Characteristics** (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Input Capacitance | $C_{ies}$ | $V_{CE}$ = 30V | - | 1070 | - | pF |
| Output Capacitance | $C_{oes}$ | $V_{GE}$ = 0V | - | 45 | - | |
| Reverse Transfer Capacitance | $C_{res}$ | f = 1MHz | - | 18 | - | |
| Total Gate Charge | $Q_g$ | $V_{CE}$ = 300V | - | 40 | - | nC |
| Gate - Emitter Charge | $Q_{ge}$ | $I_C$ = 20A | - | 9 | - | |
| Gate - Collector Charge | $Q_{gc}$ | $V_{GE}$ = 15V | - | 15 | - | |
| Turn - on Delay Time | $t_{d(on)}$ | $I_C$ = 20A, $V_{CC}$ = 400V | - | 22 | - | ns |
| Rise Time | $t_r$ | $V_{GE}$ = 15V, $R_G$ = 10Ω | - | 27 | - | |
| Turn - off Delay Time | $t_{d(off)}$ | $T_j$ = 25°C | - | 75 | - | |
| Fall Time | $t_f$ | Inductive Load | - | 60 | - | |
| Turn - on Delay Time | $t_{d(on)}$ | $I_C$ = 20A, $V_{CC}$ = 400V | - | 22 | - | ns |
| Rise Time | $t_r$ | $V_{GE}$ = 15V, $R_G$ = 10Ω | - | 29 | - | |
| Turn - off Delay Time | $t_{d(off)}$ | $T_j$ = 175°C | - | 84 | - | |
| Fall Time | $t_f$ | Inductive Load | - | 120 | - | |
| Reverse Bias Safe Operating Area | RBSOA | $I_C$ = 60A, $V_{CC}$ = 520V<br>$V_P$ = 650V, $V_{GE}$ = 15V<br>$R_G$ = 50Ω, $T_j$ = 175°C | FULL SQUARE | | | - |
| Short Circuit Withstand Time | $t_{sc}$ | $V_{CC} \leqq$ 360V<br>$V_{GE}$ = 15V<br>$T_j$ = 25°C | 5 | - | - | µs |

●**FRD Electrical Characteristics** (at $T_j$ = 25°C unless otherwise specified)

| Parameter | Symbol | Conditions | Values | | | Unit |
|---|---|---|---|---|---|---|
| | | | Min. | Typ. | Max. | |
| Diode Forward Voltage | $V_F$ | $I_F$ = 20A<br>$T_j$ = 25°C<br>$T_j$ = 175°C | -<br>- | 1.45<br>1.25 | 1.9<br>- | V |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 20A<br>$V_{CC}$ = 400V<br>$di_F/dt$ = 200A/μs<br>$T_j$ = 25°C | - | 58 | - | ns |
| Diode Peak Reverse Recovery Current | $I_{rr}$ | | - | 6.3 | - | A |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 0.20 | - | μC |
| Diode Reverse Recovery Time | $t_{rr}$ | $I_F$ = 20A<br>$V_{CC}$ = 400V<br>$di_F/dt$ = 200A/μs<br>$T_j$ = 175°C | - | 256 | - | ns |
| Diode Peak Reverse Recovery Current | $I_{rr}$ | | - | 10.4 | - | A |
| Diode Reverse Recovery Charge | $Q_{rr}$ | | - | 1.35 | - | μC |

## ●Electrical Characteristic Curves

Fig.1 Power Dissipation vs. Case Temperature

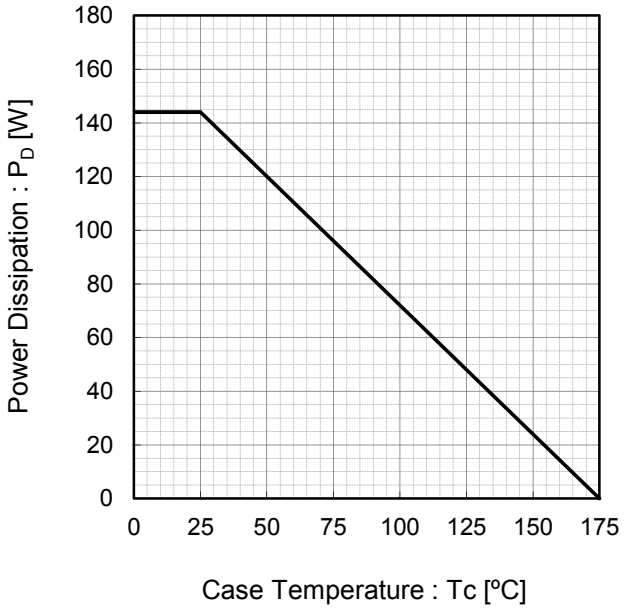



Fig.2 Collector Current vs. Case Temperature

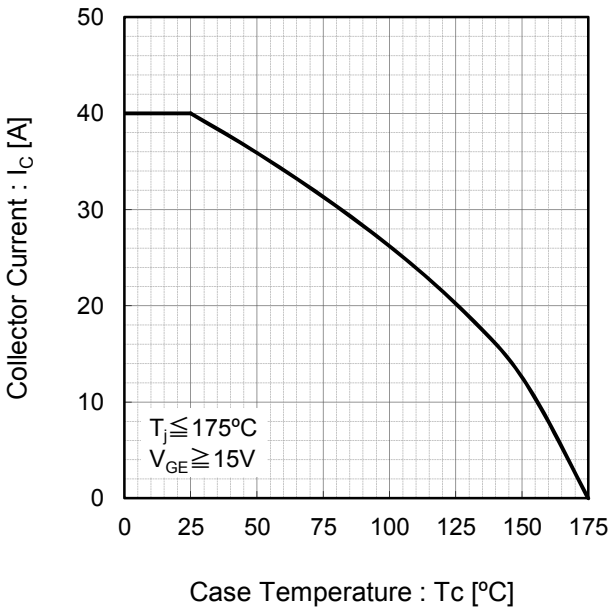



Fig.3 Forward Bias Safe Operating Area

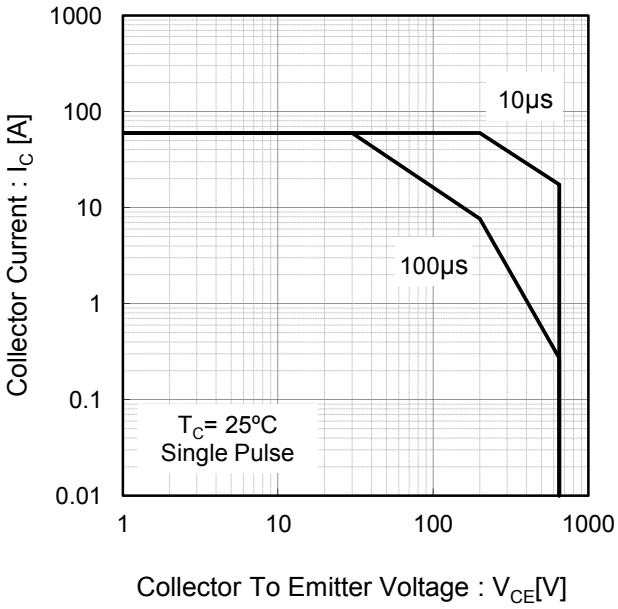
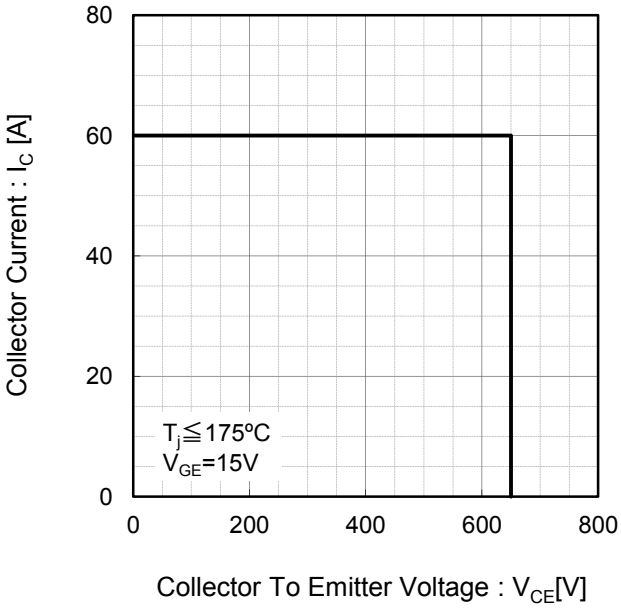



Fig.4 Reverse Bias Safe Operating Area



## ●Electrical Characteristic Curves

Fig.5 Typical Output Characteristics

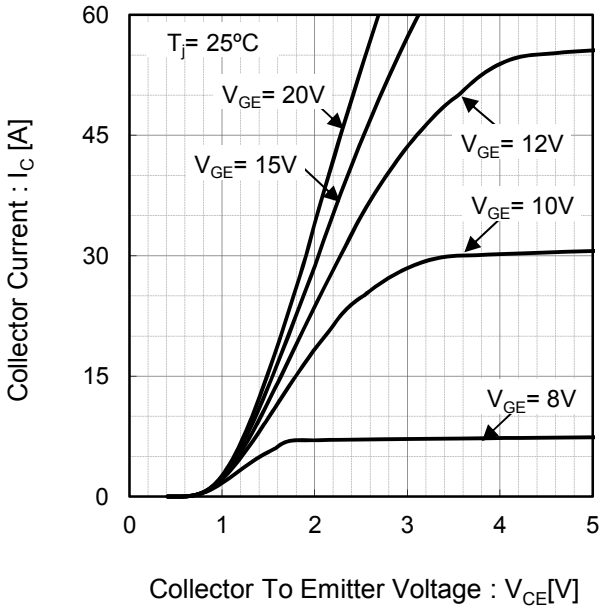



Fig.6 Typical Output Characteristics

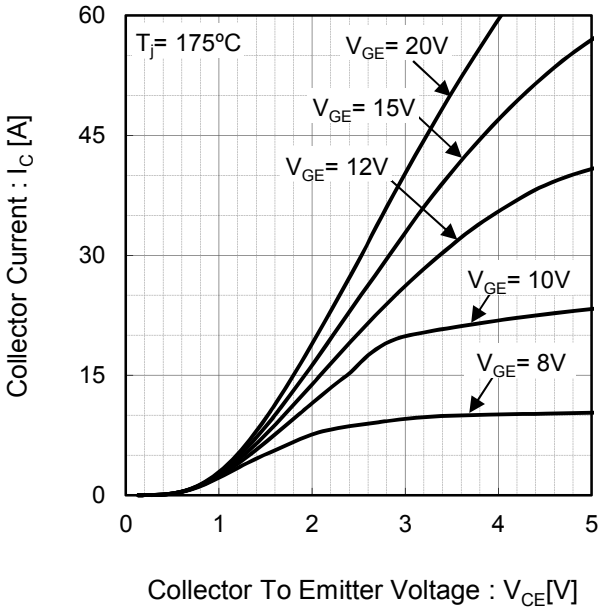



Fig.7 Typical Transfer Characteristics

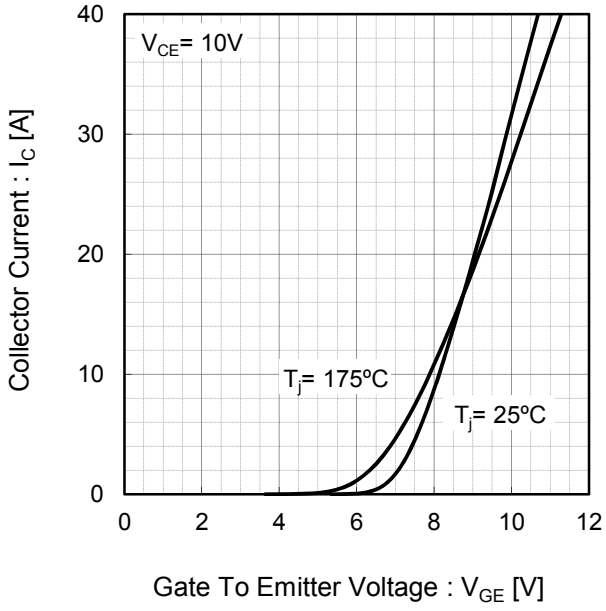
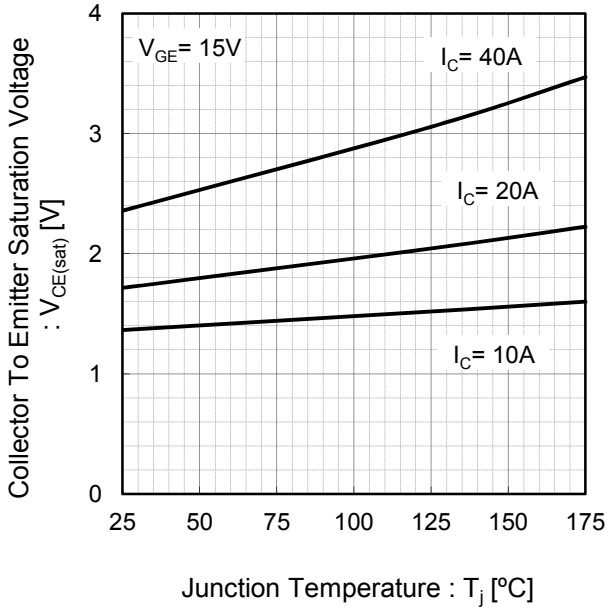



Fig.8 Typical Collector To Emitter Saturation Voltage vs. Junction Temperature



## ●Electrical Characteristic Curves

Fig.9 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

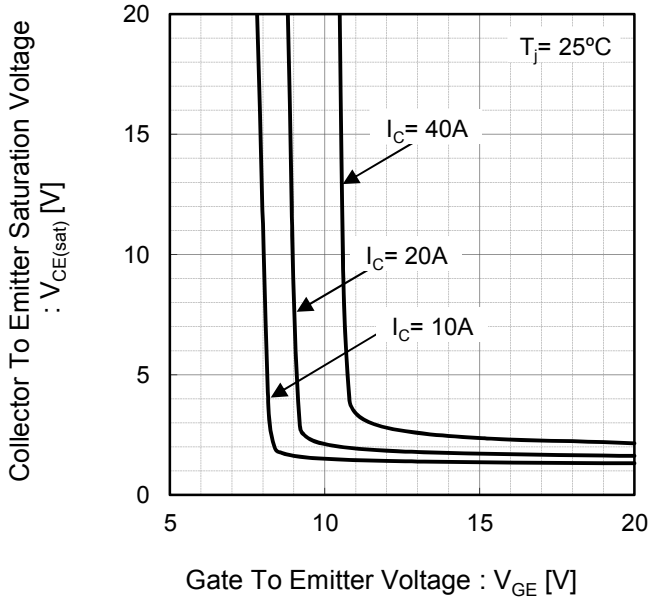



Fig.10 Typical Collector To Emitter Saturation Voltage vs. Gate To Emitter Voltage

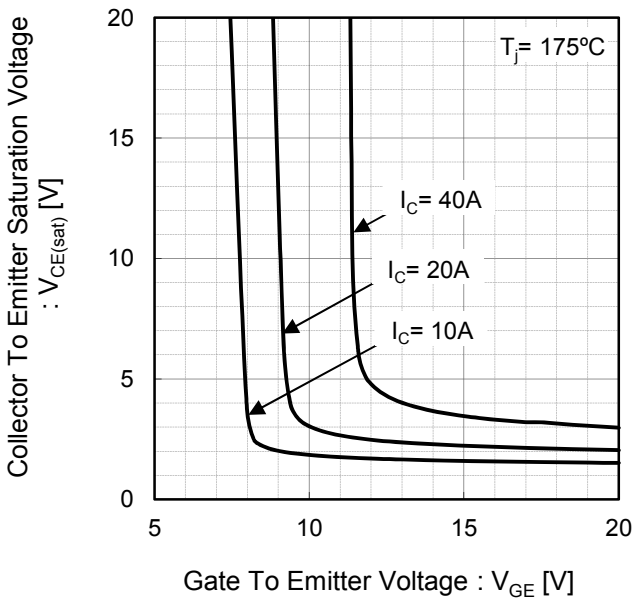



Fig.11 Typical Switching Time vs. Collector Current

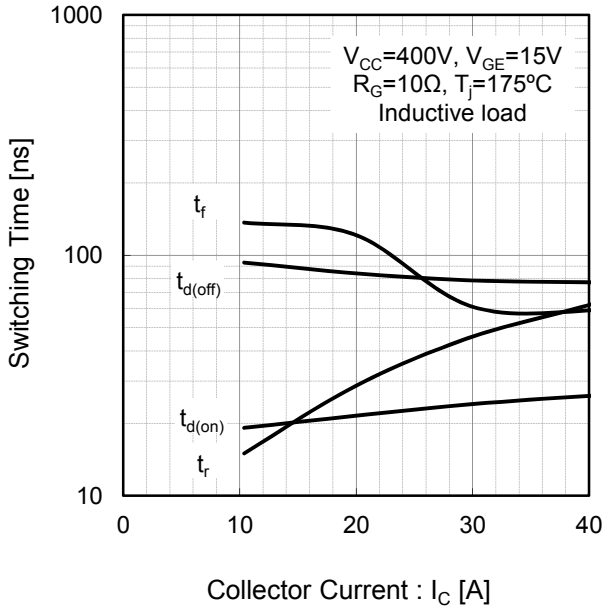
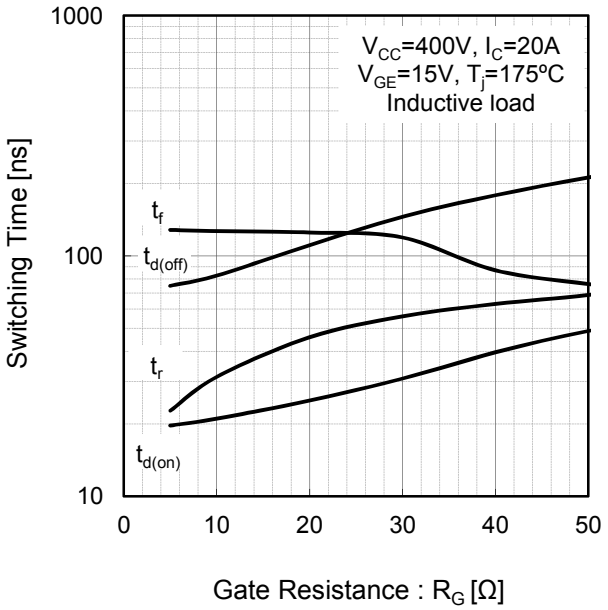



Fig.12 Typical Switching Time vs. Gate Resistance



## ●Electrical Characteristic Curves

Fig.13 Typical Switching Energy Losses vs. Collector Current

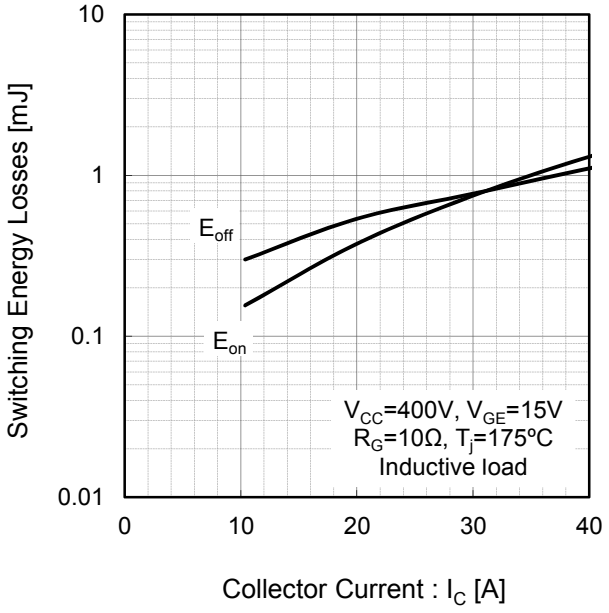



Fig.14 Typical Switching Energy Losses vs. Gate Resistance

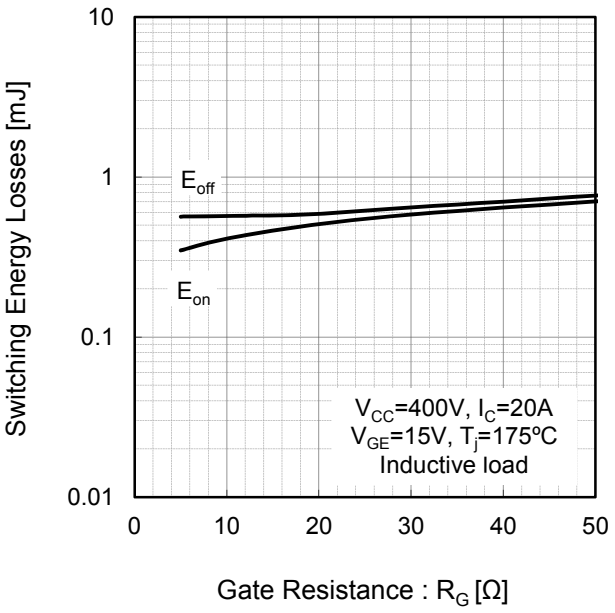



Fig.15 Typical Capacitance vs. Collector To Emitter Voltage

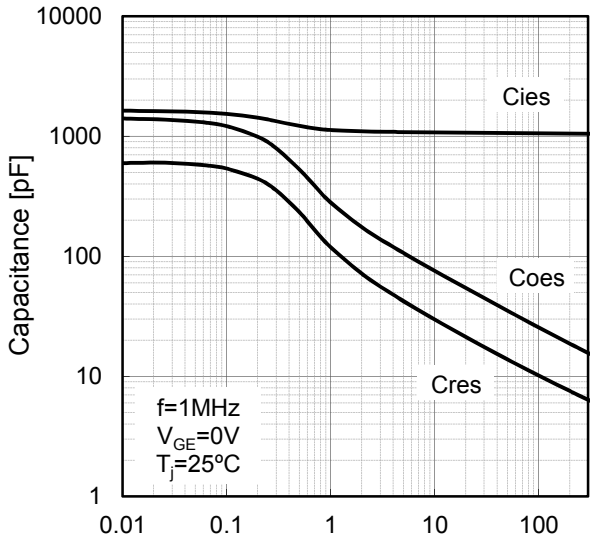
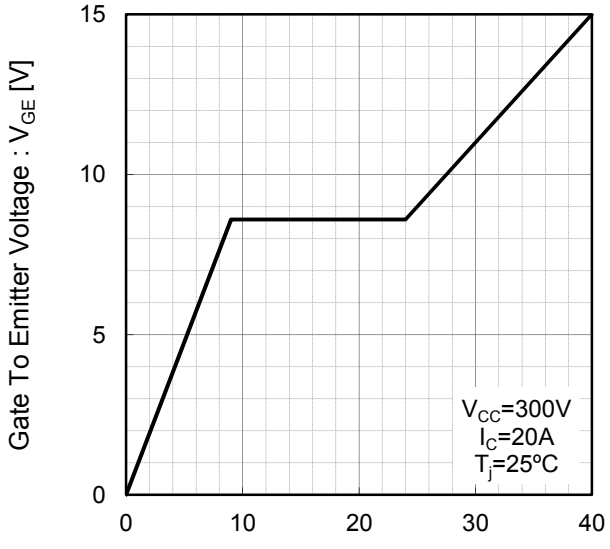



Fig.16 Typical Gate Charge



## ●Electrical Characteristic Curves

Fig.17 Typical Diode Forward Current vs. Forward Voltage

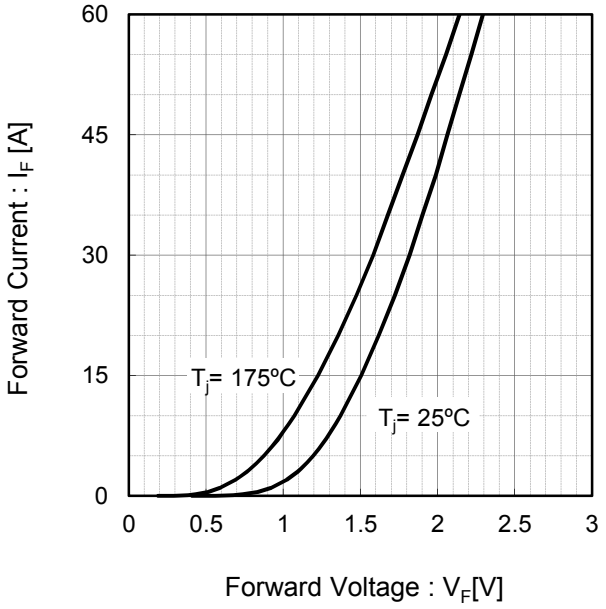



Fig.18 Typical Diode Reverse Recovery Time vs. Forward Current

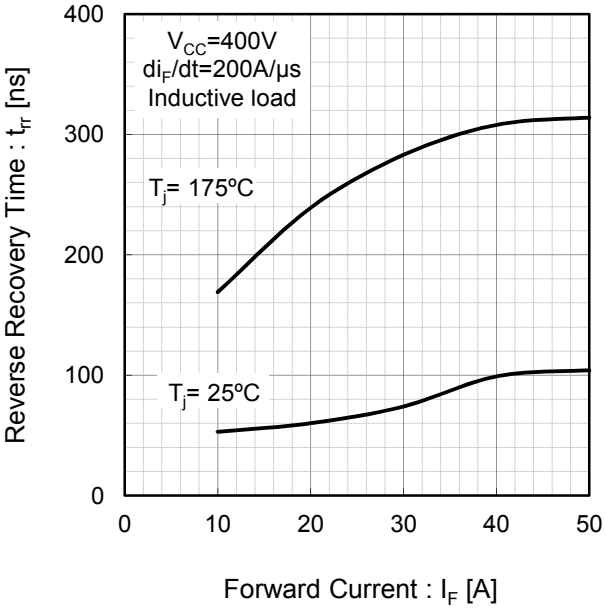



Fig.19 Typical Diode Reverse Recovery Current vs. Forward Current

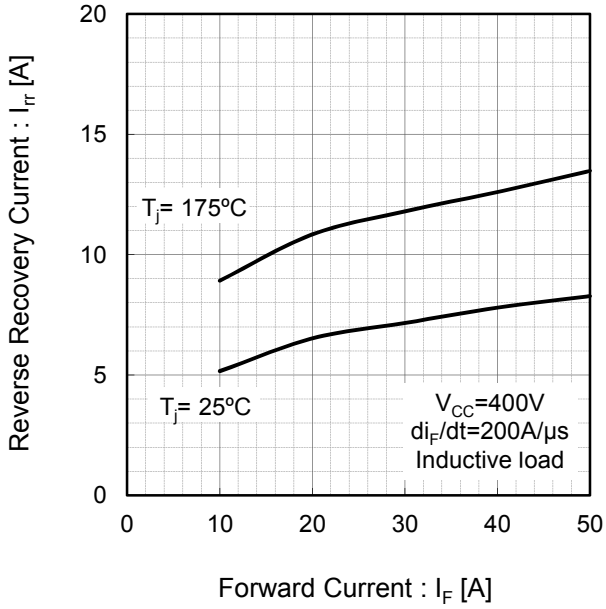
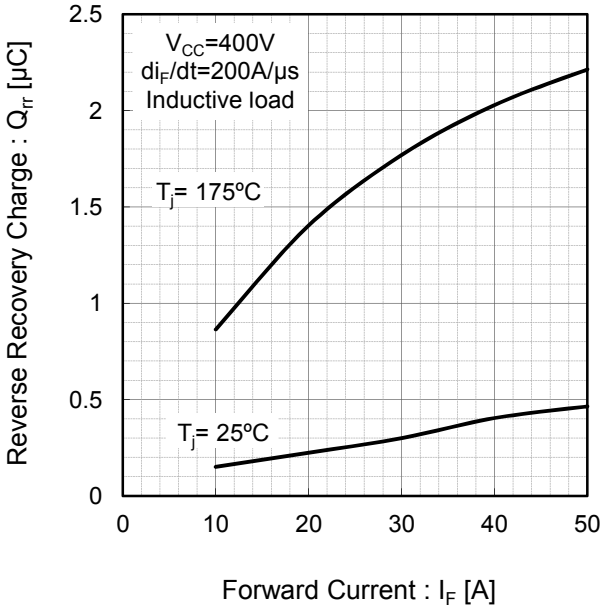



Fig.20 Typical Diode Reverse Recovery Charge vs. Forward Current



## ●Electrical Characteristic Curves

Fig.21 IGBT Transient Thermal Impedance

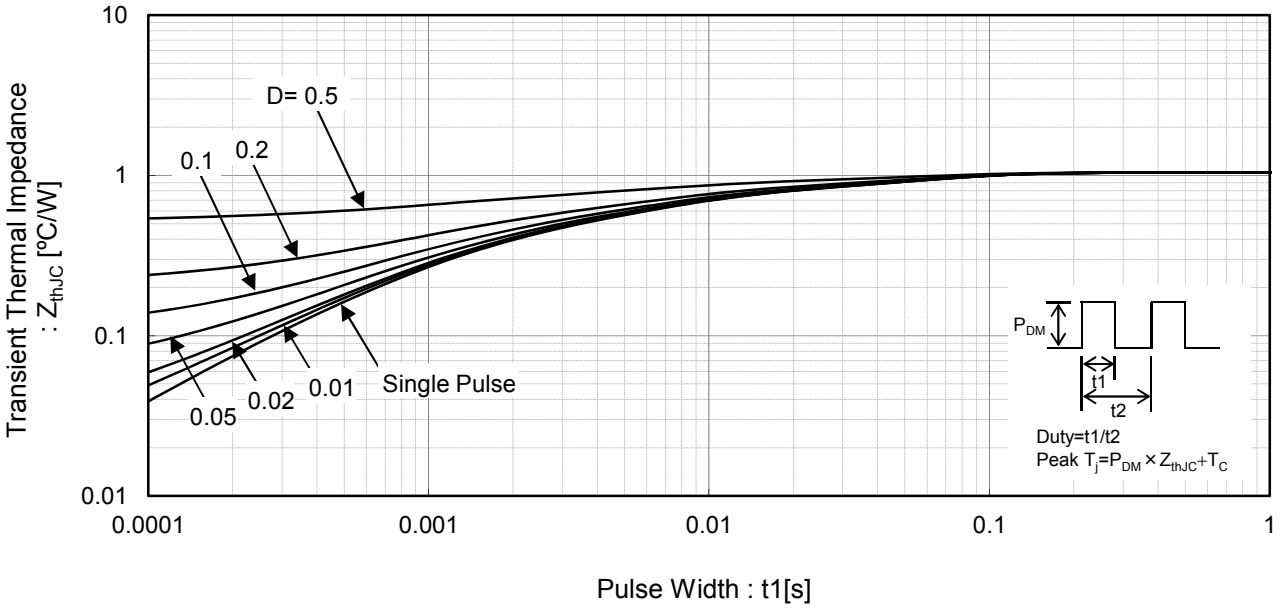
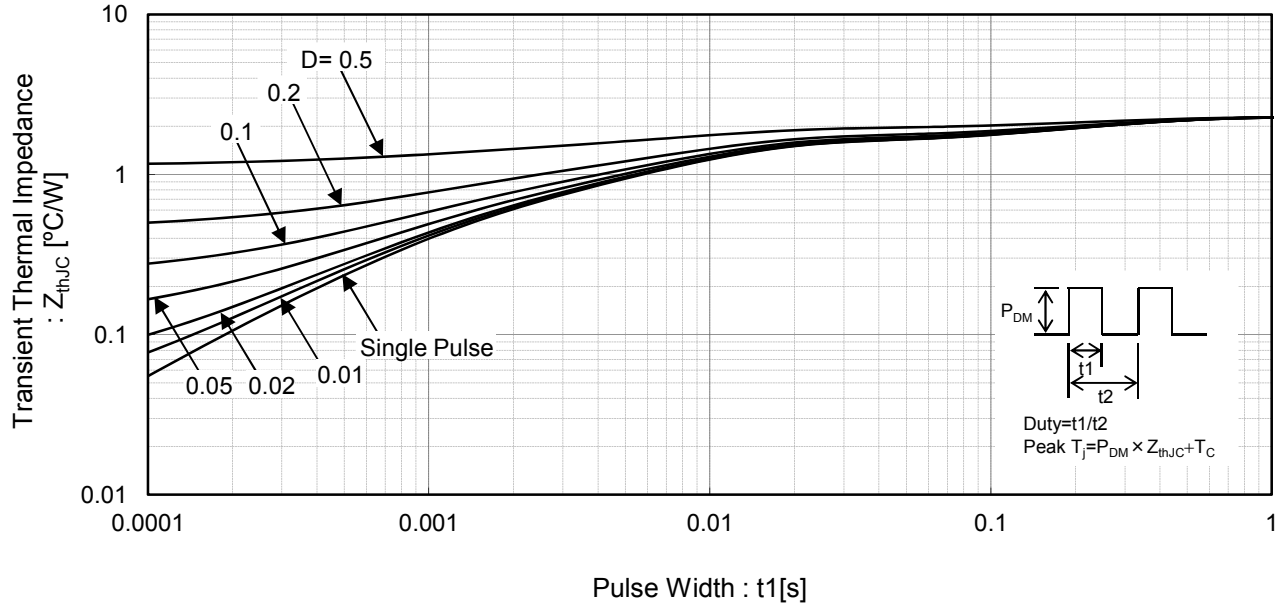



Fig.22 Diode Transient Thermal Impedance



## ●Inductive Load Switching Circuit and Waveform

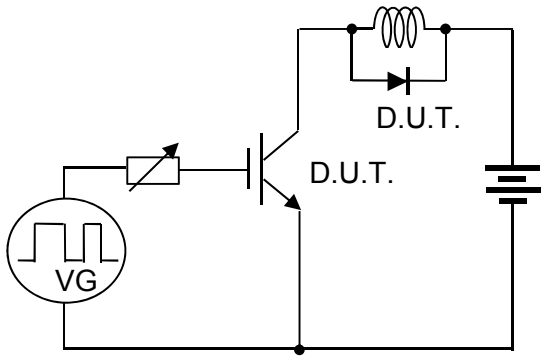



Fig.23 Inductive Load Circuit

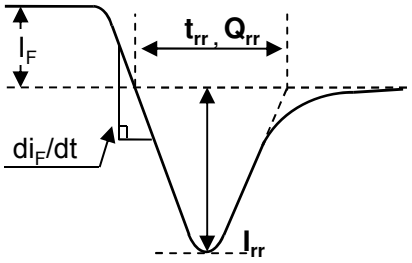



Fig.25 Diode Reverce Recovery Waveform

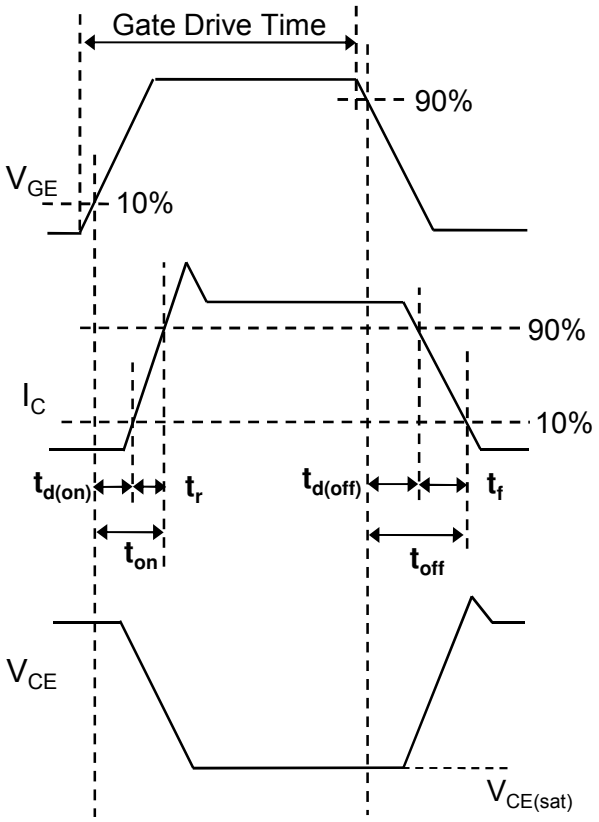



Fig.24 Inductive Load Waveform

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# RGT40TS65D - Web Page

Distribution Inventory

| | |
|---|---|
| Part Number | RGT40TS65D |
| Package | TO-247N |
| Unit Quantity | 450 |
| Minimum Package Quantity | 450 |
| Packing Type | Bulk |
| Constitution Materials List | inquiry |
| RoHS | Yes |